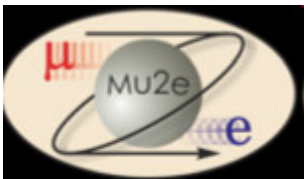


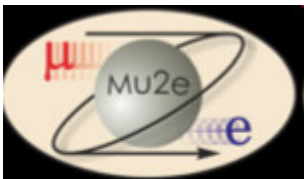
Mu2e Transverse Tracker Simulation

S. Keshvari - Rice University
Mu2e Collaboration Meeting
Fermilab
8/7/2009



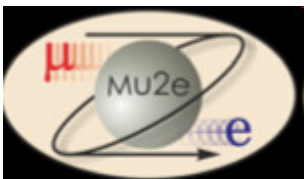
[TTracker Investigation]

- Why TTracker
- Geometry
- Requirements of Simulation
- Simulation Status



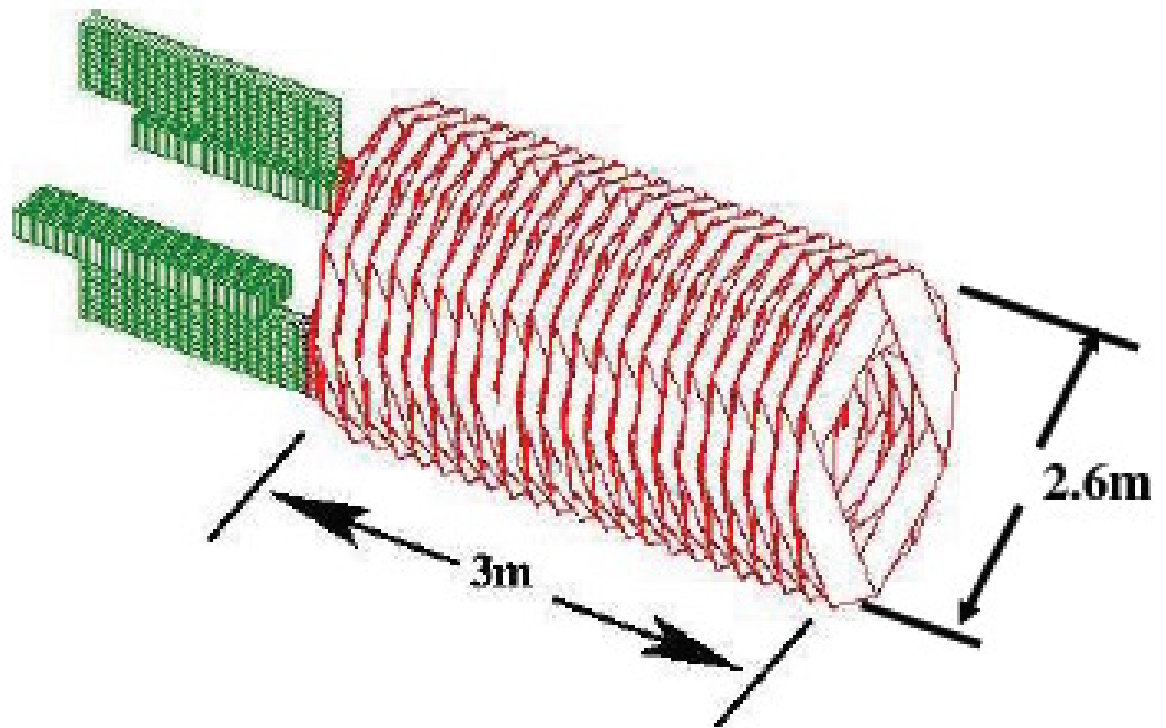
[TTracker Advantages]

- No cathode strips for azimuthal hit position
 - Use stereo angle between rotated planes
- Supporting structures outside tracker
 - Away from experiment electrons
- Modular design for easy repairs
 - Tracker length adjustable

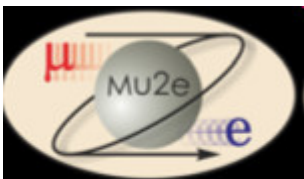


[Geometry]

- 54 Planes (or “devices”) with 4 straw layers each
- Each device rotated 60° from neighbors
- Each plane has 4 sectors which are layers of straws
- Each layer holds 64 straws in total, with varying lengths
- 12,960 total straws



From Ed Hungerford, RSVP Review, 4/2005.



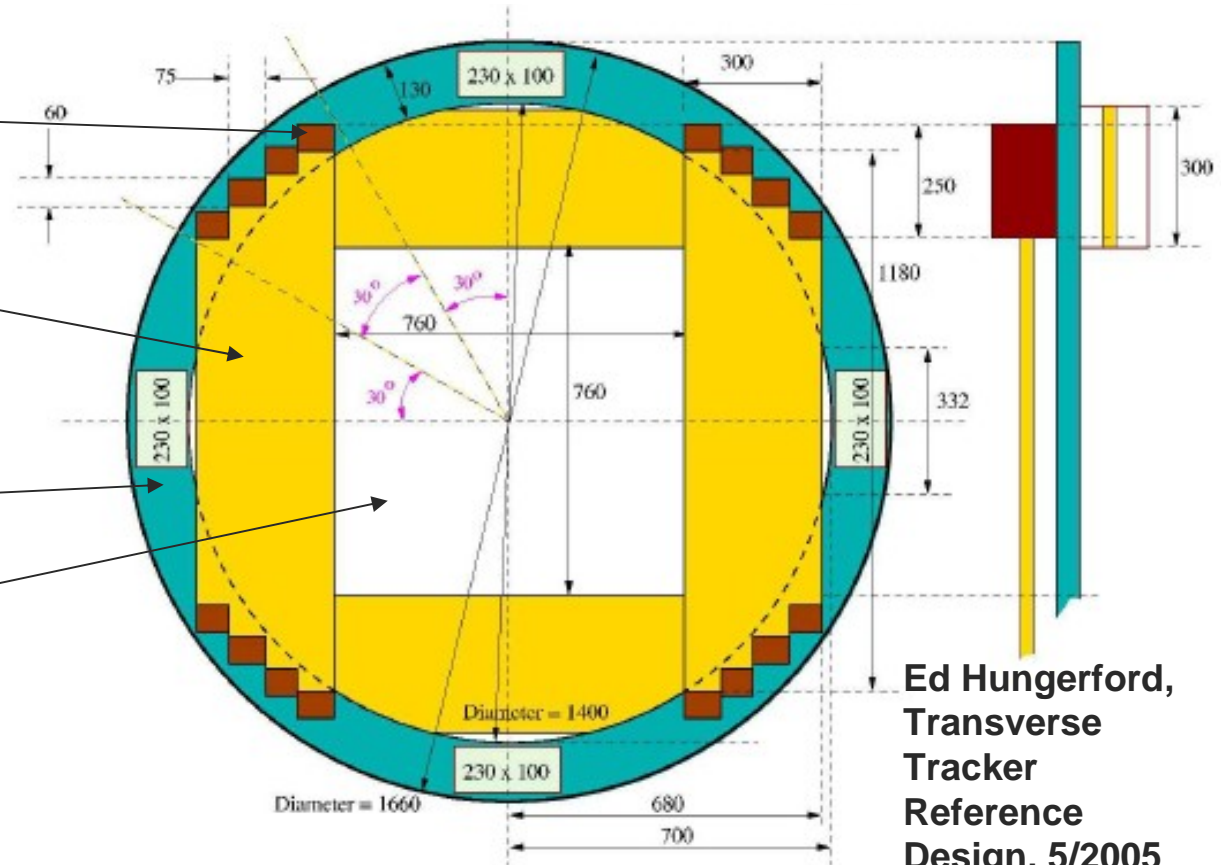
Geometry cont.

Manifolds for gas distribution and support.
Four manifolds per sector

Straw layer with 64 straws per sector. Two sectors in front of support and two behind.

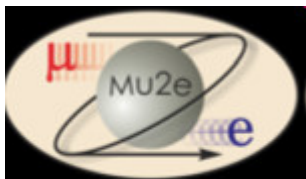
Support structure to hold parts and electronics

Empty center to avoid detecting low MeV electrons

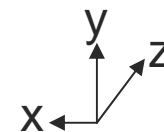
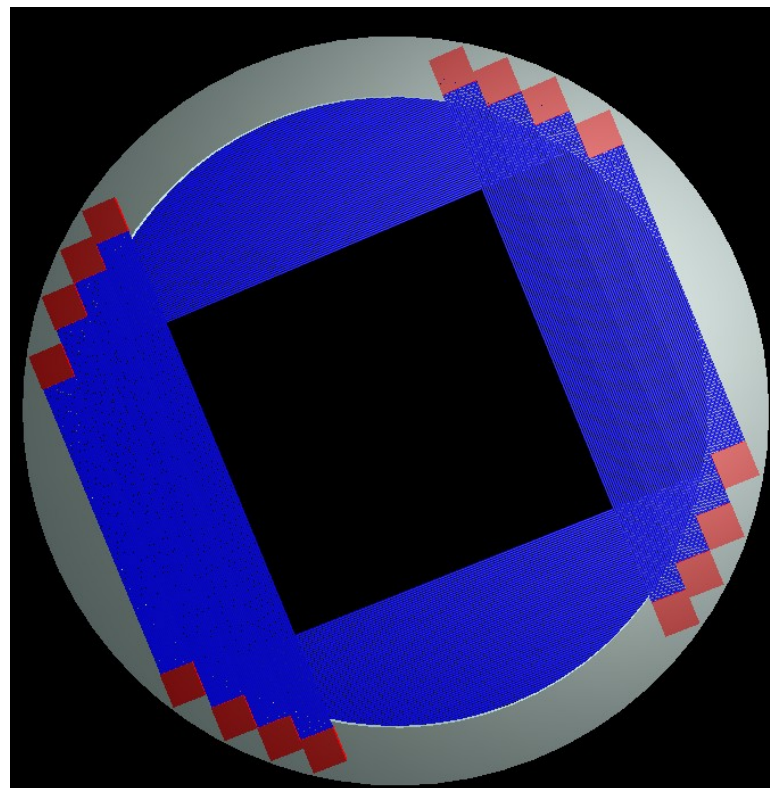


Ed Hungerford,
Transverse
Tracker
Reference
Design, 5/2005

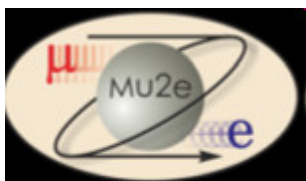
Figure 3.1 – A cross-section of a MECO T-Tracker plane showing the trapezoidal straw arrays; two on the front and two on the back of the straw plane. Straws are shown in yellow; gas manifolds are in brown. Dimensions shown are in mm.



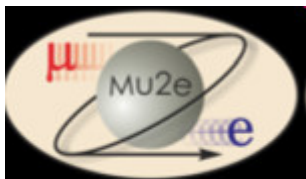
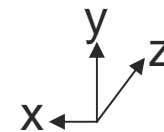
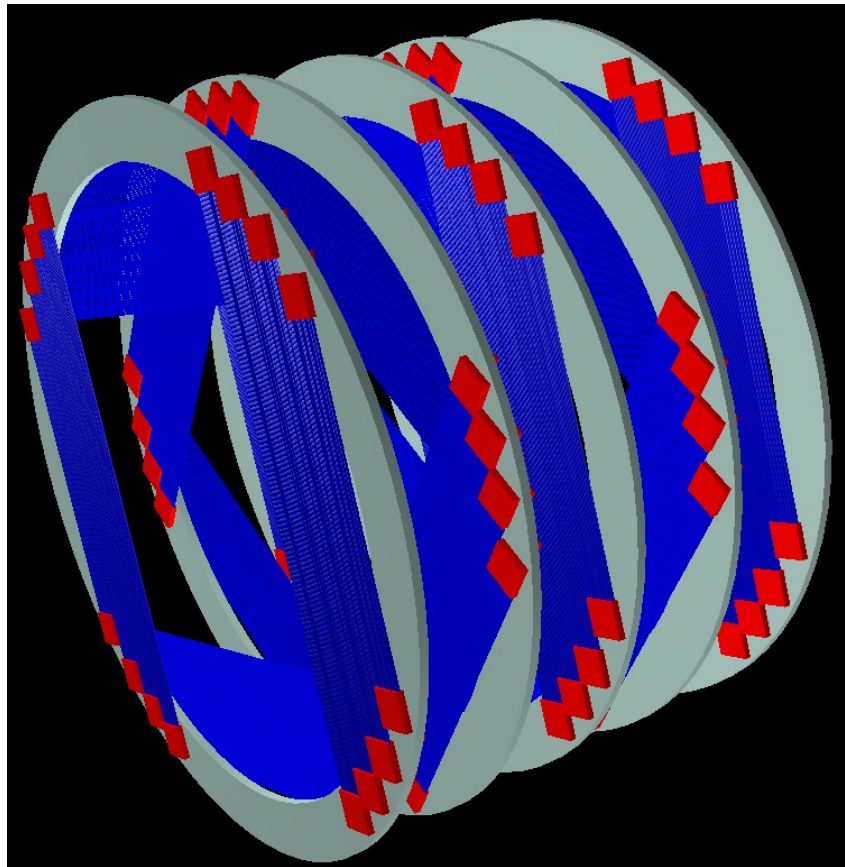
[Root Images]



3D images
from root's
GL viewer



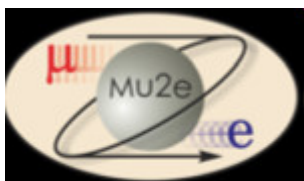
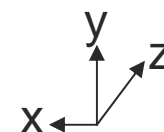
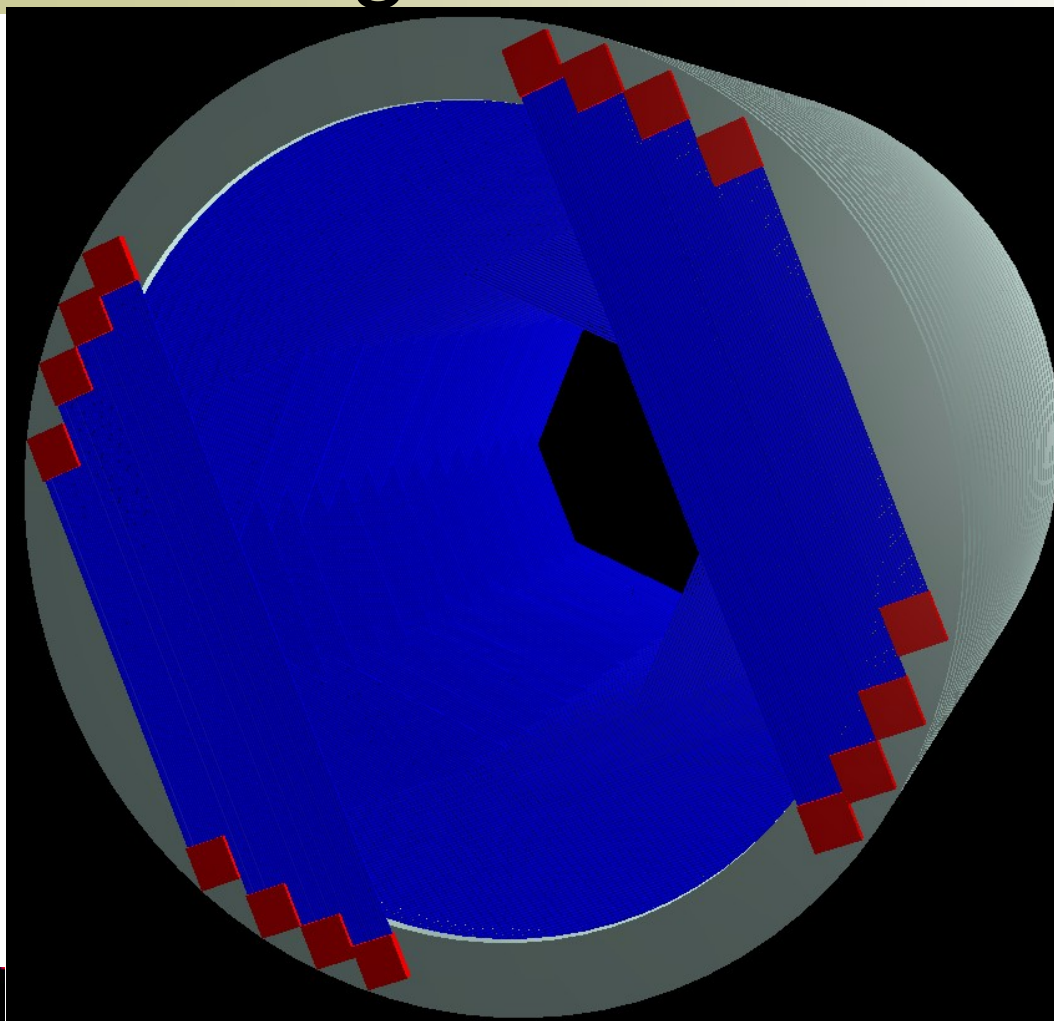
[Root Images]



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8/7/09

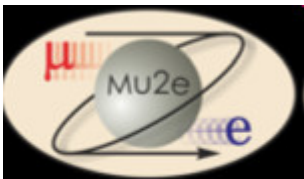
$2/3 \cdot \pi$ plane
rotation shown

[Root Images]



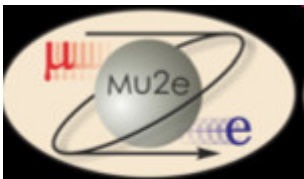
[Simulation]

- Require full Geant4 implementation
- Simulate every straw, wire, and supporting structure
- Find TTracker resolution
- Decide on global parameters
 - Geometry - component orientation and number
 - Materials - Straw wall thickness, gas, etc.

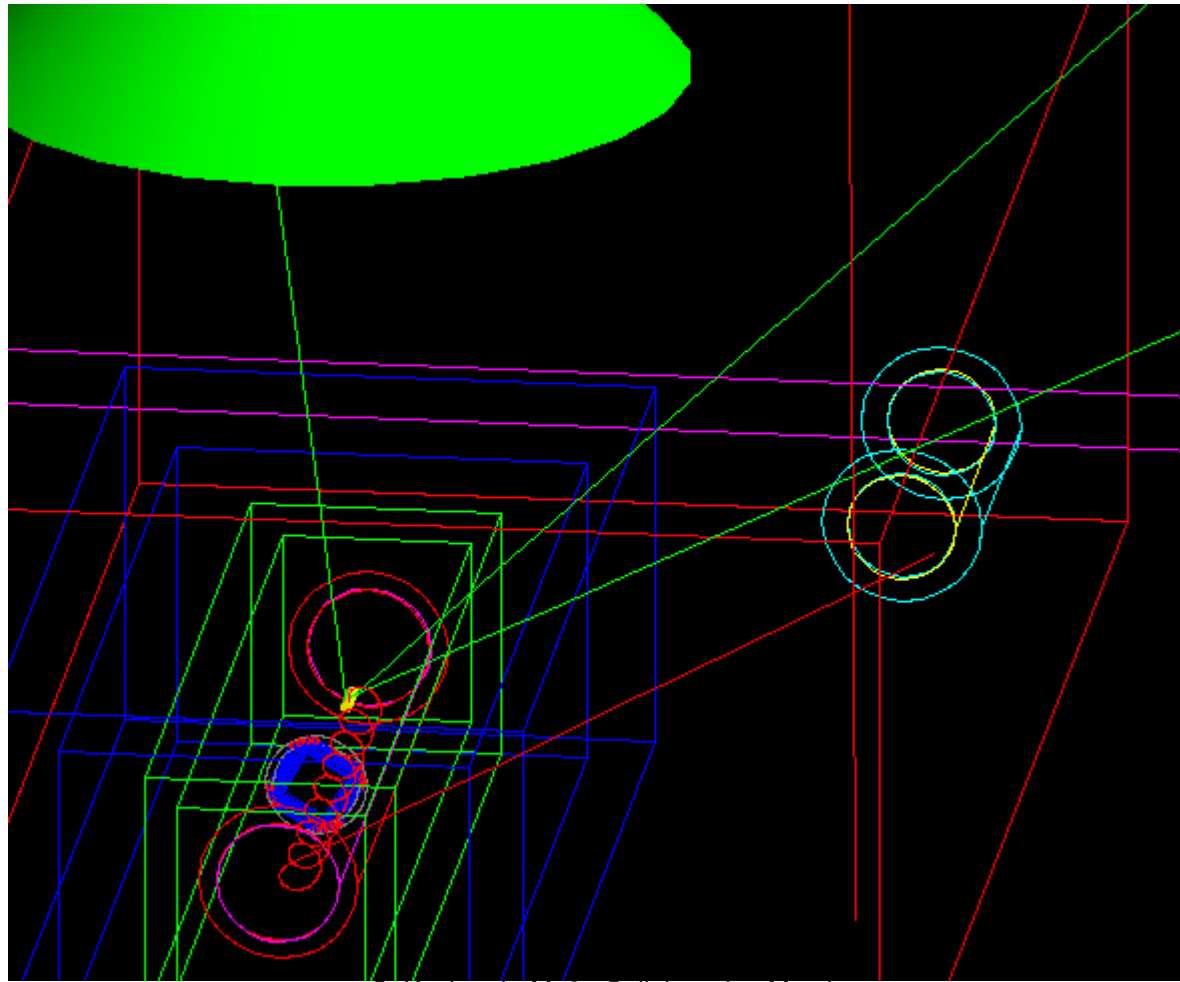


[Simulation Status]

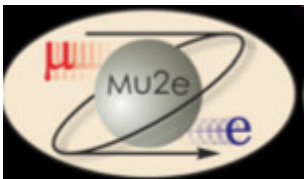
- Completed TTracker basic geometry
- Visualization in root's Open-GL
- Geant4 implementation available with most materials defined
- Debugging Geant4 implementation



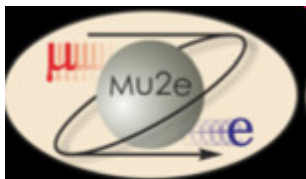
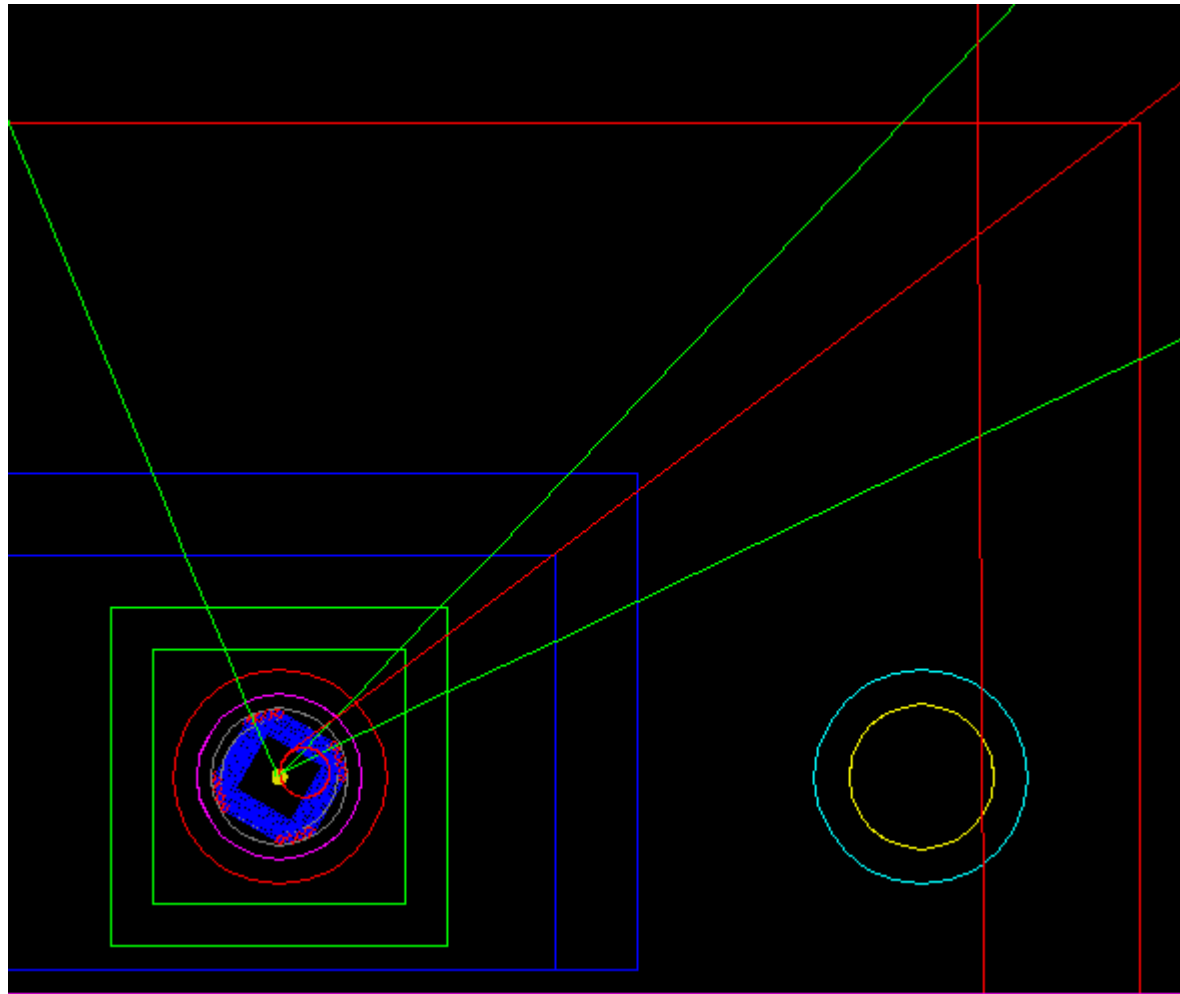
[Geant4 Images]



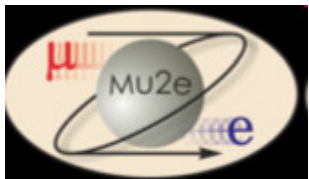
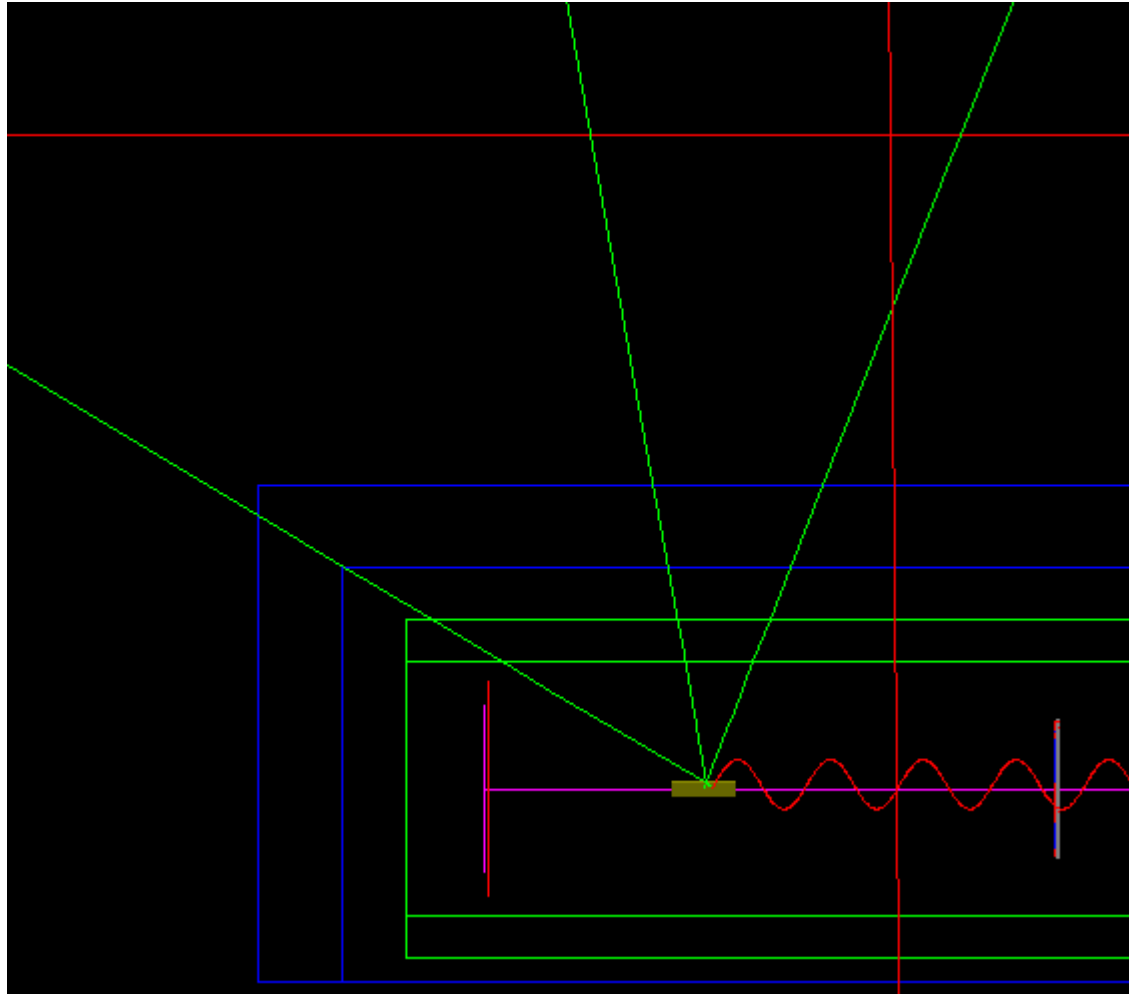
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8/7/09



[Geant4 Images]



[Geant4 Images]



[Code Structure]

- *TTracker* class takes in minimum necessary parameters for the tracker
- Constructs all objects that go into making the tracker and sets their properties
- Has vectors holding each physical object for getting/setting parameters

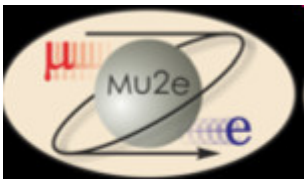
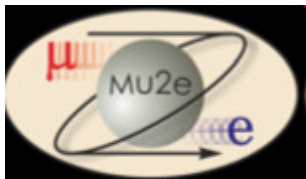
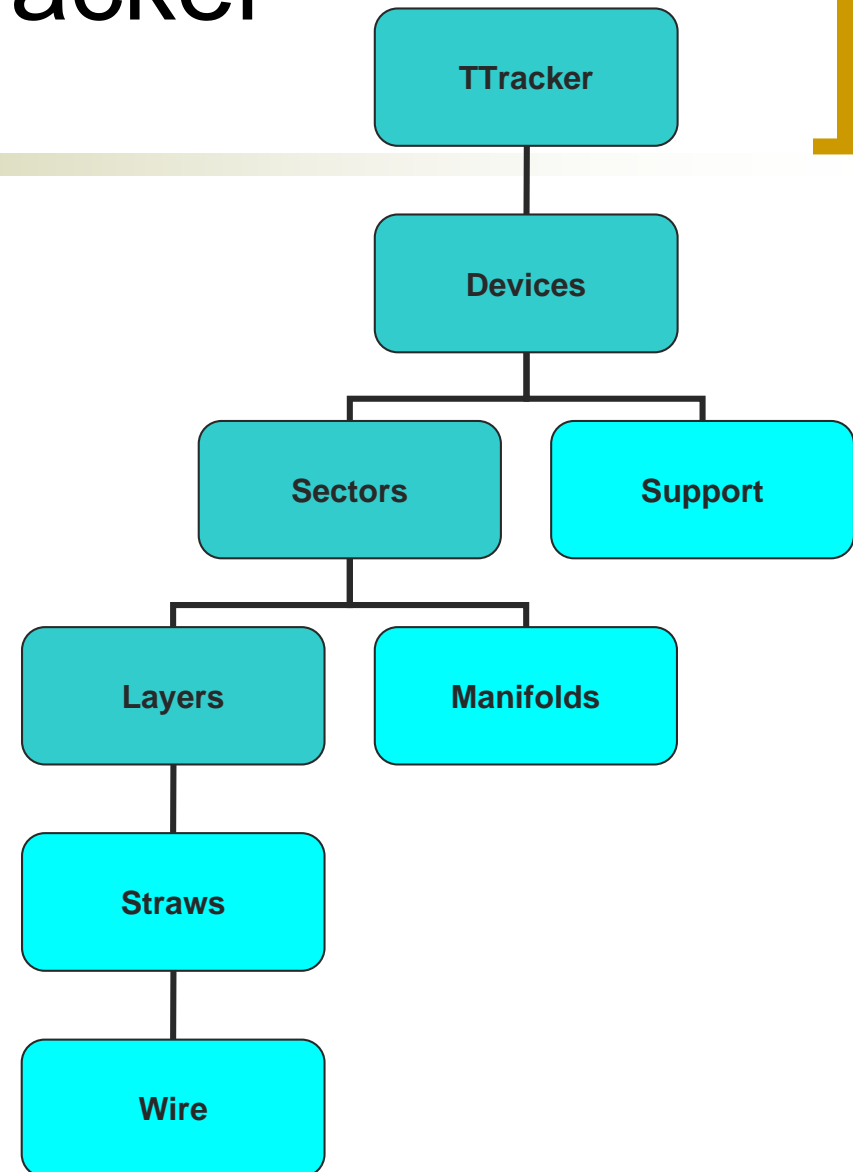


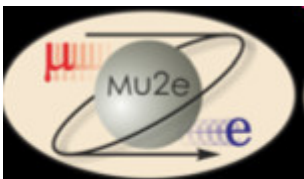
Diagram of TTracker Construction

- Each object also has a ID class for referencing within the TTracker
- Light colors represent physical objects



[Future work]

- Finish detailing the physical representation
- Possibly implement “nearest neighbor” code for straw identification
- Test the effect of multiple straw layers
- Combine with calorimeter



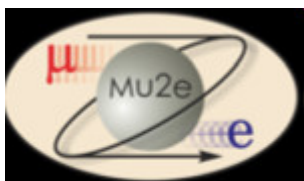
Backup: Parameters

Parameter	Nominal Value
Number of Planes	54
Straw Arrays per Plane	4
Straws per Array	64 (4×16)
Total Straws in the Detector	13824
Total Array Width	30 cm
Rotation Angle Between Consecutive Planes	60°
Plane to Plane Axial Separation	~ 5.7 cm
Overall Detector Length	302 cm

Parameter	Nominal Value
Drift Gas Composition	CF ₄ /C ₄ H ₁₀ in the ratio of 80/20
Operating Voltage	1800 V
Gas Gain	$\sim 5 \times 10^4$
Operating current	~ 1 μ A/wire (up to 10 μ A/wire during beam gate)

Parameter	Nominal Value
Anode Wire Material	Gold-coated Tungsten containing 3% Rhenium
Anode Wire Diameter	25 μ m
Anode Wire Tension	80 g
Straw Inner Diameter	5.00 mm
Straw Lengths	70-130 cm
Straw Material	Kapton
Straw Metalization & Thickness	1500 \AA of Copper
Straw Wall Thickness	15 or 25 μ m

Ed Hungerford,
Transverse
Tracker
Reference
Design, 5/2005



[Backup: Settable Parameters]

strawRadius -- Radius of each straw

strawThickness -- Thickness of straw walls

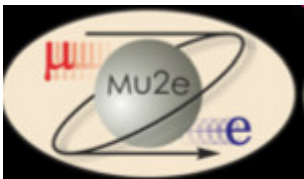
numDevices -- Number of devices (planes)

deviceSeperation -- Separation between each device

deviceRotation -- Rotation between devices

numLayers -- Number of straw layers per sector (in progress)

innerSupportRadius -- Inner radius of support structure



Backup: Settable Parameters cont.

outerSupportRadius -- Outer radius of support structure

supportThickness -- Thickness (z dimension) of support structure

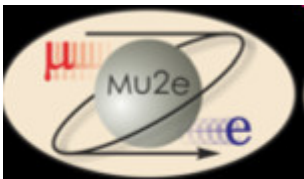
squareSideLength -- Length of inner square (for low MeV e^-)

numManifolds -- Number of manifolds per sector (divided by 2)

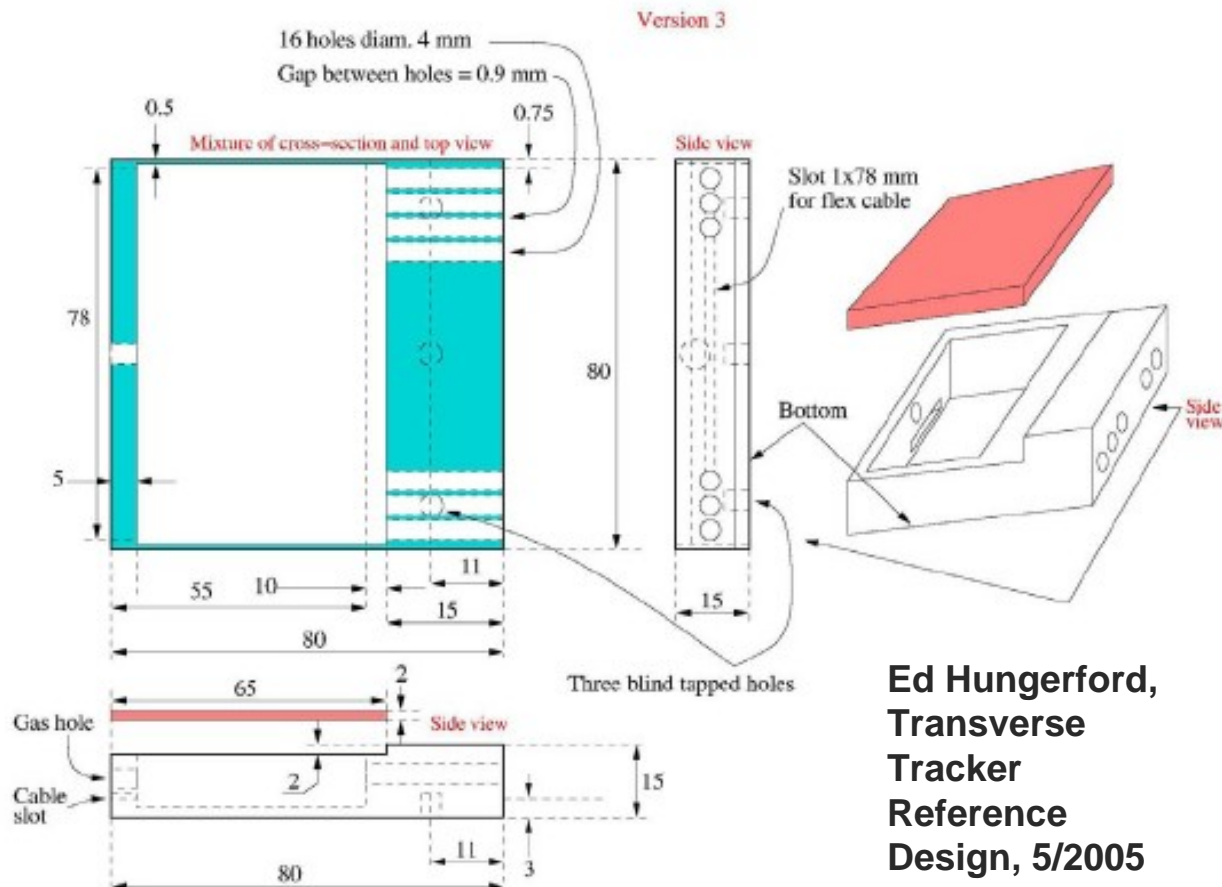
manifoldDim -- Dimensions of manifolds

strawsPerManifold -- Number of straws attached to each manifold

strawMaterial -- ID for a straw material



[Backup: Manifold Detail]



Ed Hungerford,
Transverse
Tracker
Reference
Design, 5/2005

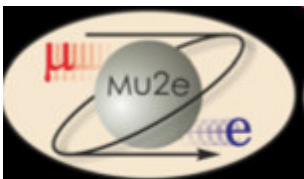


Figure 3.4 – A schematic drawing of a manifold that will contain and position 16 straws.